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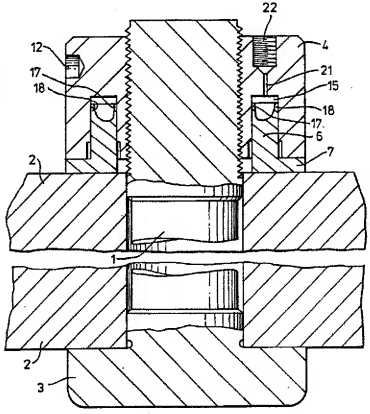
(57) Abstract

An annular piston and cylinder device comprises an annular cylinder and a piston therefor, the piston having sidewall portions which extend into the cylinder towards the base thereof in the form of tapering annular webs which together define between them a recess of asymmetrical cross section.



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Improvements in and relating to fasteners

This invention relates to hydraulically operated fastening devices. It is in particular concerned with hydraulic nuts, bolts and jacking tools used for tensioning bolts, including stud bolts.

Such devices are well known. For example EP-A-91783 discloses an arrangement in which a hydraulic jacking tool is built into the face of a nut, bolt or as a tool in its own right. Common to most devices of this type is an annular body which can be mounted in encircling relation to a bolt which is to be tensioned and which further features an annular piston and cylinder device arranged to exert force on the bolt in an axial direction.

Such devices have been used for many years, for example to secure marine propellers and also in the general industrial fastening field. A typical example is a threaded nut having an annular recess machined into one face to constitute the cylinder of a piston and cylinder

device. The recess is equipped with an annular rubber tyre and an annular piston. In use, the nut is threaded onto a bolt so that the free end of the piston, which is usually in the form of a flange known as the load ring, abuts the hardware from which the bolt projects. Hydraulic fluid is then admitted into the tyre via a passage through the nut body and the tyre in turn applies thrust to the piston. This thrust is then transmitted directly to the assembly, causing an increase in the axial length of the bolt together with compression of the assembly. As a result, the nut body is urged away from the assembly and the bolt is subjected to tension. Once a suitable gap has opened up, shims are inserted into the space between the underside face of the nut body and the load ring so that the tension in the bolt is maintained after the hydraulic pressure is relieved. Similar results may be obtained by building an annular piston and cylinder device into the head of a conventional bolt. For somewhat lighter duty application, it is possible to replace the tyre with conventional piston seals, in the form of rubber rings.

Attempts have been made to use such piston and cylinder devices to tension bolts in applications where relatively high temperatures are experienced. For example there are applications in land based gas and steam turbines and in the nuclear industry. However at the operating temperatures concerned, which may be in excess of 250^{o}C,

the use of conventional rubber seals and rubber tyres is impracticable. Prolonged exposure to temperatures above around 150°C cause rapid deterioration of conventional rubbers. Accordingly, in an attempt to overcome this problem, it has been proposed to use a metal tyre. Whilst this solution is susceptible of use at temperatures as high as 500°C, the metal tyre is an expensive item requiring special techniques for its manufacture.

According to this invention a hydraulic nut, bolt or jacking tool comprises an annular piston and cylinder device, the piston having axially directed sidewall portions constituted by a pair of tapering annular webs which constitute the only fluid sealing means for said piston and cylinder device, the radially innermost web being thinner than the other web to confer greater flexibility on said innermost web, the webs together defining between them an annular recess whose cross-section is asymmetrical. The webs preferably have substantially the same heither in an axial direction, towards of the base of the recess.

The piston is preferably a tight, sliding fit in the cylinder and no conventional rubber seal is employed. Surprisingly, it has been discovered that by use of the asymmetric profile just mentioned it is possible to configure the webs such that a conventional seal is not

required. This means that a piston and cylinder device according to this invention is susceptible of use at elevated temperatures in excess of 500°, there being no conventional seal to deteriorate under such conditions. It has been observed that a symmetrical recess does not provide the sealing performance which is required.

To illustrate the effectiveness of the invention, a sample hydraulic nut according to this invention was pressurised to stress a bolt. The bolted assembly was thereafter subjected to sustained temperatures of the order of 250°C, in an oven. On removing the assembly from the oven, it proved possible to re-energise the nut and only after it had been re-energised several times was there any sign of slight leakage. In view of the lack of a conventional seal, this performance was quite outstanding.

In order that the invention be better understood, a preferred embodiment of it will now be described by way of example with reference to the accompanying drawing in which the sole figure is a cross sectional side view through a nut and bolt assembly. In the figure, a bolt 1 having a head 3 is used to clamp together an assembly generally designated 2. It will be appreciated that the bolt extends through an aperture in the assembly 2. The free end of the bolt is provided with a hydraulic nut in the form of cylindrical body 4 having an internal screw

thread corresponding to that of the bolt 1. The nut 4 is screwed down the bolt, a plurality of tommy bar holes 12 being provided for this purpose. That face of the nut which in use contacts the hardware 2 is provided with an annular piston and cylinder device, comprising a cylinder 15 and a piston 6 which is integral with a load ring 7, the latter abutting against the hardware 2. A port 21 is provided for the injection of hydraulic fluid into the cylinder 15; a screw threaded coupling adaptor 22 being provided for this purpose. That portion of the piston 6 which is in use exposed to hydraulic fluid in the cylinder 15 is provided with annular webs 17 and 18 respectively. Although these are of the same height in an axial direction, the annular recess defined between them is asymmetrical. The effect of the asymmetry is such that the web 17 lying radially inwardly of the device is relatively thin compared with the web 18 lying radially outwardly of it. In consequence of this, the web 17 has increased flexibility over that of the web 18. Initally both webs were machined to be a tight but sliding fit in the cylinder 15. In use, with the load ring 7 flush with the face of the nut 4 (with the piston fully retracted) the nut is screwed down firmly against the hardware 2. Hydraulic fluid is then admitted through the adaptor 22 and the port 21 to the cylinder 15. The pressure is thereafter increased causing the nut body 4 to be displaced away from the load ring 7, opening up a gap

between the components. When the gap width reaches a point at which a desired level of stress in the bolt 1 has been achieved, shims or distance pieces are inserted into the gap. The hydraulic pressure is thereafter relieved, thereby completing the installation procedure.

To remove the nut for example after a prolonged period at elevated temperature, the procedure is reversed. Oil is admitted under pressure to the cylinder 15; the bolt is subjected to sufficient further stress until the shims or distance pieces can be removed. The hydraulic pressure is thereafter relieved and the nut unscrewed, using the tommy bar holes 12.

Claims

1. A hydraulic nut, bolt or jacking tool comprising an annular piston and cylinder device (6, 15), characterised in that the piston has axially directed sidewall portions constituted by a pair of tapering annular webs (17, 18) which constitute the only fluid sealing means for said piston and cylinder device, the radially innermost web (17) being thinner than the other web (18) to confer greater flexibility on said innermost web, the webs together defining between them an annular recess whose cross-section is asymmetrical.

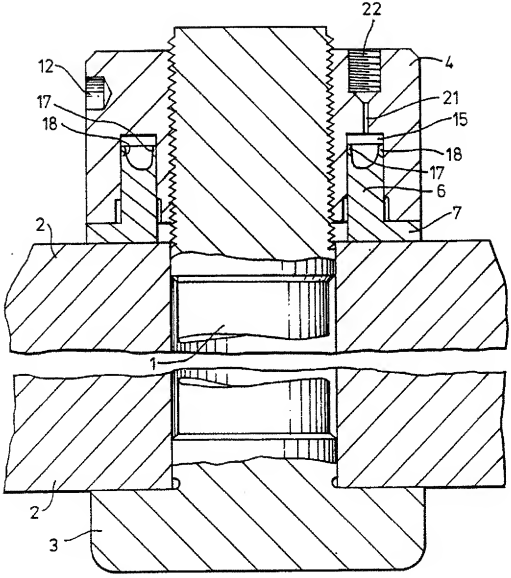
2. A device according to claim 1 characterised in that said webs have substantially the same height in an axial direction.

3. A device according to any proceeding claim further characterised in that said webs are constituted as a pair of concentric feather edges (17, 18) directed towards the closed base of the cylinder (15).

4. A device according to any proceeding claim characterised in that the piston and cylinder device (6, 15) is built into a nut (4).

5. A device according to any of claims 1 to 4 characterised in that the piston and cylinder device (6, 15) is built into the head of a bolt.

6. A piston and cylinder device according to any of claims 1 to 3 characterised in that the piston and cylinder device constitutes a bolt tensioning tool having an aperture therethrough which is a clearance for a bolt which is to be tensioned and the piston acts upon a screw-threaded puller engaged on the threaded portion of the bolt.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INTERNATIONAL SEARCH REPORT

PCT/GB 91/01482

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 F16B31/04

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	F16B ; B25B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
A	GB,A,1 590 131 (HYDRA-TIGHT LIMITED) 28 May 1981 see the whole document	1
A	EP,A,0 129 440 (INCO ALLOY PRODUCTS LIMITED) 27 December 1984	

* Special categories of cited documents : [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
20 MAY 1992	16.06.92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	ARESO Y SALINAS

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9101482 SA 51058

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 20/05/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-1590131	28-05-81	None	
EP-A-0129440	27-12-84	CA-A- 1250767	07-03-89
		DE-A- 3466725	12-11-87
		JP-A- 60023615	06-02-85